Chapter 15

Environment, Strategy, and Technology

General Motors Saturn Venture

Saturn was conceived as a totally new corporation, a wholly owned General Motors subsidiary that delivered its first cars in fall 1990. The formerly autonomous division, headquartered in Spring Hill, Tennessee, has its own sales and service operations. At the time, why did GM decide to separate Saturn so decisively from the existing corporate structure, rather than just add yet another product line to its Chevrolet, Oldsmobile, Pontiac, Buick, and Cadillac lines?

General Motors insiders and auto industry analysts cited two primary reasons. First, GM badly needed to find ways to cut costs to compete in the small car market, in which estimates suggested that Japanese manufacturers enjoyed a great cost advantage. Second, top GM executives hoped to use the Saturn venture as a testing ground for innovations that could be applied throughout the rest of the organization, especially ones that could get new models to the market more quickly. To accomplish both these goals, the freedom of a completely "fresh start" and the protection autonomy offered seemed to be essential.

With the exception of the use of plastic for vertical body parts, Saturn cars did not represent a radical technical departure for GM. Rather, it is the way in which the cars are built and marketed that is innovative. Extensively trained self-managed work teams assemble the cars, maintain their own equipment, order supplies, set work schedules, and even select new team members. To control quality and reduce transport costs, much subassembly

Learning Objectives

After reading Chapter 15, you should be able to:

1. Discuss the open systems concept of an organization and the components of an organization's external environment.
2. Explain how environmental uncertainty and resource dependence affect what happens in organizations.
3. Define *strategy* and describe how organizational structure can serve as a strategic response to environmental demands.
4. Explain how vertical integration, mergers, acquisitions, strategic alliances, interlocking directorates, and the establishment of legitimacy reflect strategic responses.
5. Describe the basic dimensions of organizational technology.
6. Explain how organizations must match organizational structure to technology.
7. Discuss the impact of advanced information technology on job design and organizational structure.

United Auto Workers
www.uaw.org

is done by suppliers that are located close to the plant or even within the plant itself, thus fostering a close cooperative arrangement. Parts that do come in from the outside are delivered precisely when they are needed and directly to the location where they are used in assembly. In the marketing domain, dealers are given more exclusive territories than is typical of North American auto manufacturers. As long as they meet stiff requirements in several key areas, they are given substantial autonomy to tailor their operations to local needs.

These changes in manufacturing and marketing are supported by a number of departures from conventional structure, management style, and labour relations practices. Saturn has a flatter management structure than the traditional GM divisions. A computerized "paperless" operation of electronic mail and a single, highly integrated database speed decisions and counter bureaucracy. Finally, GM agreed to a truly ground-breaking labour contract with the United Auto Workers. There are no time clocks, and workers are on salaries, although these salaries average less than industry hourly wages. In addition, restrictive work rules were eliminated to support the team assembly concept. In exchange for these concessions, GM devotes a percentage of the industry hourly wage to performance incentives and a profit-sharing plan for Saturn workers. Also, 80 percent of the workforce is granted what amounts to lifetime employment security. Union representatives sit on planning and organizing committees.

Has Saturn fulfilled the promise of its multibillion-dollar investment? Early cars suffered from quality glitches that the company attended to quickly, even replacing some faulty cars for free. As a result of such tactics and extremely cooperative dealers (many of whom organize customer picnics and car clinics), intense customer loyalty resulted in Saturn turning a profit three years after the first car rolled off the assembly line. However, the company has been in the red most years and has not recouped the initial investment. Many observers have noted the failure of other parts of GM to embrace the Saturn innovations. The United Auto Workers have consistently resisted Saturn-type labour agreements at any other man-

ufacturing sites. Saturn has been slow to develop new models, and competitors are outpacing the company in terms of technical refinement and safety, even copying some of its "buyer-friendly" sales techniques. Although Saturn buyers have good demographics in terms of income and education, the company has been slow to develop larger sedans, minivans, and sports utility vehicles to offer them. Gaining investment funds for such projects from GM has been difficult because the parent firm has been busy recentralizing much vehicle development and engineering.

Four years after its startup, Saturn became part of the GM Small Car Group. This required Saturn leadership to work even harder to ensure the spirit of the Saturn partnership remained strong. Even though organizational and market changes challenged Saturn's unique culture, the original memorandum of agreement between Saturn and its workers was renewed in late 1999. Currently, Saturn and the international UAW are considering returning the Saturn workforce to the UAW-GM national agreement.

In recent years, Saturn has been rebuilding its aging product line. In a long-awaited move, it finally introduced a sport/utility vehicle marking the first expansion in the division's history beyond its coupes, sedans and station wagons, sending a signal that Saturn is now in the truck business. In December of 2001, the new Vue sport-utility vehicle was unveiled followed by a complete restyling of its mid-sized L-Series. In 2002, Saturn unveiled the Ion to replace the S-Series, the car that first launched Saturn more than thirteen years ago, and in 2003 unveiled the Relay minivan. In addition, GM recently opened its first new assembly plant in 15 years. The new Lansing Grand River plant has been designed to improve efficiency and to create a worker-friendly environment and features a new manufacturing system.[1]

The Saturn story illustrates some of the major questions that we will consider in this chapter. How does the external environment influence organizations? How can an organization develop a strategy to cope with this environment? And how can technology and other factors be used to implement strategy? In the previous chapter, we concluded that there is no one best way to design an organization. In this chapter, we will see that the proper organizational structure is contingent on environmental, strategic, and technological factors.

The External Environment of Organizations

In previous chapters, we have been concerned primarily with the internal environments of organizations—those events and conditions inside the organization—that affect the attitudes and behaviours of members. In this section, we turn our interest to the impact of the **external environment**—those events and conditions surrounding the organization that influence its activities.

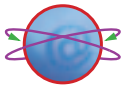
External environment. Events and conditions surrounding an organization that influence its activities.

There is ample evidence in everyday life that the external environment has tremendous influence on organizations. The OPEC oil embargo of 1973 and subsequent oil price increases shook North American automobile manufacturers to their foundations. Faced with gasoline shortages, increasing gasoline prices, and rising

interest rates, consumers postponed automobile purchases or shifted to more economical foreign vehicles. As a consequence, workers were laid off, plants were closed, and dealerships failed, while the manufacturers scrambled to develop more fuel-efficient smaller cars. The emphasis of advertising strategies changed from styling and comfort to economy and value. Significant portions of the manufacturers' environment (Middle East oil suppliers, American consumers, and Japanese competitors) prompted this radical regrouping.

Environmental conditions change, and by the mid-1980s an international oil surplus pushed gasoline prices down. Consumers responded with increased interest in size, styling, and performance. Auto industry analysts noted that some manufacturers responded to this shift faster than others. Chrysler, trimmed of bureaucracy by its near demise several years earlier, responded quickly and scored a number of marketing coups. General Motors responded less quickly, and the Saturn project was an attempt to enable the company to respond more quickly to environmental trends.

In the new millennium, the auto industry faces accelerated global competition, especially to supply the increasing middle class in the developing countries. Joint ventures and mergers between companies, such as the $48-billion global merger between Chrysler and Daimler-Benz, have become common.



CIBC World Markets
www.cibcwm.com

A more recent example of the influence of the external environment on organizations is the terrorist attacks in the United States on September 11, 2001. This had a major effect on many companies, such as World Markets, the investment banking arm of CIBC and the Canadian company hit hardest by the terrorist attacks. The company was forced to evacuate nearly 2,000 employees from its offices across the street from where the World Trade Center twin towers once stood. All of the company's employees survived the attacks, but the firm lost its equities trading floor, which was the centerpiece of its U.S. business. Teamwork and esprit de corps helped World Markets build a new trading floor from scratch in six weeks, instead of the six to nine months that it would normally take.[2] Other companies had to lay off workers and some had to change the way they conduct their business. For example, because many employees were unwilling to travel following the terrorist attacks, the use of technology such as videoconferencing became much more popular for communication and training. Organizations have also become much more sensitive to work–life balance issues and workplace diversity.

The SARS outbreak is also a good example of the influence of the external environment. When SARS hit Toronto, bus, hotel, restaurant, theatre, and travel com-

CIBC World Markets had to evacuate nearly 2,000 employees from its offices across the street from where the World Trade Center twin towers once stood and build a new trading floor from scratch.

panies were deluged with cancellations and experienced a sharp decline in business. SARS forced Toronto-based Cullingford Coaches to idle many of its 17 coaches and face the prospect of having part of its fleet repossessed.[3] It has been estimated that the overall effect of SARS on the economy from lost tourism and airport revenues is about $570 million in Toronto and another $380 million in the rest of Canada. The losses are even greater in the Asian countries that experienced SARS outbreaks much greater than those in Canada.[4] In addition, many companies noticed that they could operate just as well with less business travel than they did before SARS. Some realized large savings in time and money by using technology such as videoconferencing.[5] Both the terrorist attacks and SARS have resulted in lasting changes in the way many companies now do business, especially in terms of the use of technology. As always, the external environment profoundly shapes organizational behaviour.

Organizations as Open Systems

Organizations can be described as open systems. **Open systems** are systems that take inputs from the external environment, transform some of these inputs, and send them back into the external environment as outputs (Exhibit 15.1).[6] Inputs include capital, energy, materials, information, technology, and people; outputs include various products and services. Some inputs are transformed (e.g., raw materials), while other inputs (e.g., skilled craftspeople) assist in the transformation process. Transformation processes may be physical (e.g., manufacturing or surgery), intellectual (e.g., teaching or programming), or even emotional (e.g., psychotherapy). For example, an insurance company imports actuarial experts, information about accidents and mortality, and capital in the form of insurance premiums. Through the application of financial knowledge, it transforms the capital into insurance coverage and investments in areas such as real estate. Universities and colleges import seasoned scholars and aspiring students from the environment. Through the teaching process, educated individuals are returned to the community as outputs.

Open systems. Systems that take inputs from the external environment, transform some of them, and send them back into the environment as outputs.

The value of the open systems concept is that it sensitizes us to the need for organizations to cope with the demands of the environment on both the input side and the output side. As we will see, some of this coping involves adaptation to environmental demands. On the other hand, some coping may be oriented toward changing the environment.

First, let us examine the external environment in greater detail.

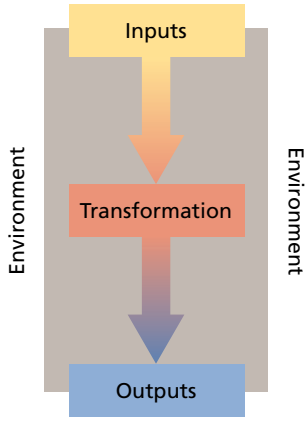


Exhibit 15.1
The organization as an open system.

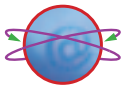
Components of the External Environment

The external environment of any given organization is obviously a "big" concept. Technically, it involves any person, group, event, or condition outside the direct domain of the organization. For this reason, it is useful to divide the environment into a manageable number of components.[7]

The General Economy. Organizations that survive through selling products or services often suffer from an economic downturn and profit by an upturn. When a downturn occurs, competition for remaining customers increases, and organizations might postpone needed capital improvements. Of course, some organizations thrive under a poor economy, including welfare offices and law firms that deal heavily in bankruptcies. In addition, if a poor economy is accompanied by high unemployment, some organizations might find it opportune to upgrade the quality of their staffs, since they will have an ample selection of candidates.

We see a clear example of the impact of the general economy in the most recent recession. Faced with falling orders (reduced inputs), thousands of organizations engaged in radical downsizing as a means of cutting costs.

Customers. All organizations have potential customers for their products and services. Piano makers have musicians, and consumer activist associations have disgruntled consumers. The customers of universities include not only students, but also the firms that employ their graduates and seek their research assistance. Organizations must be sensitive to changes in customer demands. For example, the small liberal arts college that resists developing a business school might be faced with declining enrolment.



L'Oréal
www.loreal.com

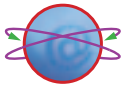
Successful firms are generally highly sensitive to customer reactions. L'Oréal, the world's largest producer of cosmetics, announced that it would no longer test its products on animals in response to customer demand. Taco Bell moved to a nonsmoking environment in its company-owned restaurants as a result of a year-long survey that showed that the majority of both smokers and nonsmokers preferred a smoke-free environment in restaurants.

Suppliers. Organizations are dependent on the environment for supplies that include labour, raw materials, equipment, and component parts. Shortages can cause severe difficulties. For instance, the lack of a local technical school might prove troublesome for an electronics firm that requires skilled labour. Similarly, a strike by a company that supplies component parts might cause the purchaser to shut down its assembly line.

As alluded to earlier in the text, many contemporary firms have changed their strategy for dealing with suppliers. It used to be standard practice to have many of them and to keep them in stiff competition for one's business, mainly by extracting the lowest price. Now, more exclusive relationships with suppliers, on the basis of quality and reliable delivery, are becoming more common. Dell Computer reduced its suppliers from 140 to 80 and its freight carriers from 21 to 3.

Competitors. Environmental competitors vie for resources that include both customers and suppliers.[8] Thus, hospitals compete for patients, and consulting firms compete for clients. Similarly, utility companies compete for coal, and professional baseball teams compete for free agent ballplayers. Successful organizations devote considerable energy to monitoring the activities of competitors.

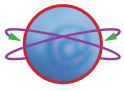
The computer software industry provides an instructive lesson in how competition can change over time. In the early days of software development (not very long ago!), there were a large number of players in the field, and small companies could find a profitable niche. There was plenty of room for many competitors in what was an essentially technology-driven business. However, the growing domination of Microsoft, which slashed prices and consolidated multiple functions in its programs, has prompted a great number of mergers, acquisitions, and failures among firms dealing in basic consumer software, such as word processing and spreadsheets.[9]



Microsoft
www.microsoft.com

For many organizations today the competition has become so aggressive that their environments have been described as hypercompetitive. Organizations that find themselves in hypercompetitive environments must become extremely flexible in order to respond quickly to changes and cope with hypercompetition.[10]

Social/Political Factors. Organizations cannot ignore the social and political events that occur around them. Changes in public attitudes toward ethnic diversity, the proper age for retirement, or the proper role of big business will soon affect them. Frequently, these attitudes find expression in law through the political process. Thus, organizations must cope with a series of legal regulations that prescribe fair employment practices, proper competitive activities, product safety, and clients' rights.



Wal-Mart
www.walmart.com

Pacific Gas and Electric
www.pge.com

One example of the impact of social trends on organizations is Wal-Mart's move to ban handgun sales in its stores. Another is the increasing public interest in environmentalism. Many firms have been fairly proactive in their responses. For example, Pacific Gas & Electric works closely with environmental groups and has

a dedicated environmentalist on its board. McDonald's has become a visible proponent of recycling and an active educator of the public on environmental issues.[11]

Technology. The environment contains a variety of technologies that are useful for achieving organizational goals. As we shall see, technology refers to ways of doing things, not simply to some form of machinery. The ability to adopt the proper technology should enhance an organization's effectiveness. For a business firm, this might involve the choice of a proper computer system or production technique. For a mental health clinic, it might involve implementing a particular form of psychotherapy that is effective for the kinds of clients serviced.

An example of the impact of technology on organizational life is the advent of computer-aided design (CAD). With CAD, designers, engineers, and draftspeople can produce quick, accurate drawings via computer. They can store databases and run simulations that produce visual records of the reaction of objects to stress, vibration, and design changes. Some firms have found that CAD reduces design lead times and increases productivity. Others have had a difficult time reorganizing to exploit this technology. In general, CAD has broken down the traditional role differences between designers, engineers, and drawing technicians.

Now that we have outlined the basic components of organizational environments, a few more detailed comments are in order. First, this brief list does not provide a perfect picture of the large number of actual interest groups that can exist in an organization's environment. **Interest groups** are parties or organizations other than direct competitors that have some vested interest in how an organization is managed. For example, Exhibit 15.2 shows the interest groups that surround a small private college. As you can see, our list of six environmental components actually involves quite an array of individuals and agencies with which the college must contend. To complicate matters, some of these individuals and agencies might make competing or conflicting demands on the college. For instance, booster clubs might press the college to allocate more funds to field a winning football team, while scholarship sponsors might insist that the college match their donations for academic purposes.

Interest groups. Parties or organizations other than direct competitors that have some vested interest in how an organization is managed.

Such competition for attention from different segments of the environment is not unusual. While antidrug organizations have sometimes supported the screening of employees for drug use, the American Civil Liberties Union has taken a keen interest

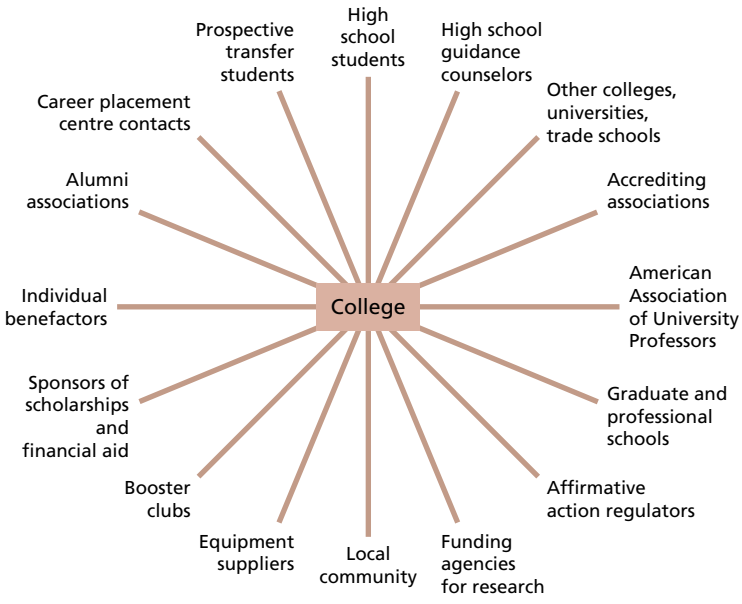


Exhibit 15.2
Interest groups in the external environment of a small private college.

Source: From Brown, W. B., & Moberg, D. J. (1980). *Organization theory and management*, p. 45. Copyright © 1980 by John Wiley & Sons, Inc. Reprinted by permission of John Wiley & Sons, Inc.

in the violation of privacy that such tests can involve. Obviously, different interest groups evaluate organizational effectiveness according to different criteria.[12]

Different parts of the organization will often be concerned with different environmental components. For instance, we can expect a marketing department to be tuned in to customer demands and a legal department to be interested in regulations stemming from the social/political component. As we indicated in the previous chapter, coordination of this natural division of interests is a crucial concern for all organizations. Also, as environmental demands change, it is important that power shifts occur to allow the appropriate functional units to cope with these demands.

Finally, events in various components of the environment provide both constraints and opportunities for organizations. Although environments with many constraints (e.g., high interest rates, strong competition, and so on) appear pretty hostile, an opportunity in one environmental sector might offset a constraint in another. For example, the firm that is faced with a dwindling customer base might find its salvation by exploiting new technologies that give it an edge in costs or new product development.

The Environment of Saturn

Let us return to the story that began the chapter and analyze some of the environmental components that shaped General Motors' plans regarding the Saturn project. A strong impetus for the Saturn venture was the $2,000 cost advantage per small car that Japanese competitors held at the time. However, cost reductions mean little unless the quality of the Saturn automobile is comparable with that of Japanese makes. To enhance quality, GM exercised particular control over parts suppliers, inducing them to locate within or near the plant to facilitate communication with Saturn engineering and manufacturing personnel.

During the recessionary early 1980s, the general economy faltered, and unions lost considerable bargaining power. Union membership fell, and GM capitalized on changing social attitudes toward unions to forge an innovative contract with the United Auto Workers. However, an interest group, the National Right to Work Legal Defence Foundation, challenged the legality of the contract. This group, which provides legal aid to workers who do not wish to join unions, argued that it was improper for GM to specify the United Auto Workers as a bargaining agent in advance of any workers having been hired.[13] The challenge failed.

Several technological advances were exploited at Saturn, although not as many as GM envisioned at the start of the project. Still, the plastic body parts are innovative, as is a sophisticated paperless database operation.

Finally, GM gambled that it could exploit a segment of customers that would not normally consider a domestic car—dedicated import buyers. It did not wish to develop a new car only to divert sales from existing GM product lines.

Clearly, Saturn is a product of environmental constraints and opportunities. But exactly how do such constraints and opportunities affect the organization? To answer this question, we turn to the concepts of environmental uncertainty and resource dependence.

Environmental Uncertainty

In our earlier discussion of environmental components, we implied that environments have considerable potential for causing confusion among managers. Customers may come and go, suppliers may turn from good to bad, and competitors may make surprising decisions. The resulting uncertainty can be both challenging and frustrating. **Environmental uncertainty** exists when an environment is vague, difficult to diagnose, and unpredictable. We all know that some environments are less certain than others. Your hometown provides you with a fairly certain environment. There, you are familiar with the transportation system, the

Environmental uncertainty. A condition that exists when the external environment is vague, difficult to diagnose, and unpredictable.

language, and necessary social conventions. Thrust into the midst of a foreign culture, you encounter a much less certain environment. How to greet a stranger, order a meal, and get around town become significant issues. There is nothing intrinsically bad about this uncertainty. It simply requires you to marshal a particular set of skills in order to be an effective visitor.

Like individuals, organizations can find themselves in more or less certain environments. But just exactly what makes an organizational environment uncertain? Put simply, uncertainty depends on the environment's *complexity* (simple versus complex) and its *rate of change* (static versus dynamic).[14]

- *Simple environment.* A simple environment involves relatively few factors, and these factors are fairly similar to each other. For example, consider the pottery manufacturer that obtains its raw materials from two small firms and sells its entire output to three small pottery outlets.
- *Complex environment.* A complex environment contains a large number of dissimilar factors that affect the organization. For example, the college in Exhibit 15.2 has a more complex environment than the pottery manufacturer. In turn, the Saturn organization has a more complex environment than the college.
- *Static environment.* The components of this environment remain fairly stable over time. The small-town radio station that plays the same music format, relies on the same advertisers, and works under the same CRTC regulations year after year has a stable environment. (Of course, no environment is *completely* static; we are speaking in relative terms here.)
- *Dynamic environment.* The components of a highly dynamic environment are in a constant state of change, which is unpredictable and irregular, not cyclical. For example, consider the firm that designs and manufactures microchips for electronics applications. New scientific and technological advances occur rapidly and unpredictably in this field. In addition, customer demands are highly dynamic as firms devise new uses for microchips. A similar dynamic environment faces Saturn, in part owing to the vagaries of the energy situation and in part owing to the fact that marketing automobiles has become an international rather than a national business. For example, fluctuations in the relative value of international currencies can radically alter the cost of competing imported cars quite independently of anything Saturn management does.

As we see in Exhibit 15.3, it is possible to arrange rate of change and complexity in a matrix. A simple/static environment (cell 1) should provoke the least uncertainty, while a dynamic/complex environment (cell 4) should provoke the most. Some research suggests that change has more influence than complexity on uncertainty.[15] Thus, we might expect a static/complex environment (cell 2) to be somewhat more certain than a dynamic/simple environment (cell 3).

Earlier, we stated that different portions of the organization are often interested in different components of the environment. To go a step further, it stands to reason that some aspects of the environment are less certain than others. Thus, some subunits might be faced with more uncertainty than others. For example, the research and development department of a microchip company would seem to face a more uncertain environment than the human resource department.

Increasing uncertainty has several predictable effects on organizations and their decision makers.[16] For one thing, as uncertainty increases, cause-and-effect relationships become less clear. If we are certain that a key competitor will not match our increased advertising budget, we may be confident that our escalated ad campaign will increase our market share. Uncertainty about the competitor's response reduces confidence in this causal inference. Second, environmental uncertainty tends to make priorities harder to agree on, and it often stimulates a fair degree of political jockeying within the organization. To continue the example, if the consequences

Exhibit 15.3
Environmental uncertainty as a function of complexity and rate of change.

From Robert B. Duncan, "Characteristics of organizational environments and perceived environmental uncertainty," Table 2: Environmental state dimensions and predicted perceived uncertainty experienced by individuals in decision units, *Administrative Science Quarterly,* vol. 17, no. 3 (September 1972), p. 320. Reprinted by permission.

of increased advertising are unclear, other functional units might see the increased budget allocation as being "up for grabs." Finally, as environmental uncertainty increases, more information must be processed by the organization to make adequate decisions. Environmental scanning, boundary spanning, planning, and formal management information systems will become more prominent.[17] This illustrates that organizations will act to cope with or reduce uncertainty because uncertainty increases the difficulty of decision making and thus threatens organizational effectiveness. Shortly, we will examine in greater detail the means of managing uncertainty. First, we explore another aspect of the impact of the environment on organizations.

Resource Dependence

Resource dependence. The dependency of organizations on environmental inputs, such as capital, raw materials, and human resources.

Earlier, we noted that organizations are open systems that receive inputs from the external environment and transfer outputs into this environment. Many inputs from various components of the environment are valuable resources that are necessary for organizational survival. These include things such as capital, raw materials, and human resources. By the same token, other components of the environment (such as customers) represent valuable resources on the output end of the equation. All this suggests that organizations are in a state of **resource dependence** with regard to their environments.[18] Carefully managing and coping with this resource dependence is a key to survival and success.

Although all organizations are dependent on their environments for resources, some organizations are more dependent than others. This is because some environments have a larger amount of readily accessible resources.[19] A classic case of a highly resource-dependent organization is a newly formed small business. Cautious bank managers, credit-wary suppliers, and a dearth of customers all teach the aspiring owner the meaning of dependence. Also, many organizations in traditional "smokestack" industries encounter a much less munificent environment. Investors

are wary, customers are disappearing, and skilled human resources are attracted to situations with better career prospects. Historically, the computer and software industries were located in munificent environments. Capital was readily available, human resources were trained in relevant fields, and new uses for computers were continually being developed. Although this is still to some extent the case, we have already alluded to the shakeout in the market for basic software. The days are gone when business amateurs can develop a new wordprocessing package and become multimillionaires, like the founders of WordPerfect. The big firms have consolidated the market.

Resource dependence can be fairly independent of environmental uncertainty, and dealing with one issue will not necessarily have an effect on the other. For example, although the computer industry generally faces a fairly munificent environment, this environment is uncertain, especially with regard to rate of change. On the other hand, many mature small businesses exist in a fairly certain environment but remain highly resource dependent.

Competitors, regulatory agencies, and various interest groups can have a considerable stake in how an organization obtains and transforms its resources.[20] In effect, the organization might be indirectly resource dependent on these bodies and thus susceptible to a fair degree of social control. For example, Saturn could have begun operations without unionization (the Nissan plant located in Tennessee is not unionized). However, other GM plants are organized by the United Auto Workers. To preclude labour difficulties and ensure the presence of committed human resources, GM agreed to United Auto Workers representation from the outset of the project.

The concept of resource dependence does not mean that organizations are totally at the mercy of their environments. Rather, it means that they must develop strategies for managing both resource dependence and environmental uncertainty.

Strategic Responses to Uncertainty and Resource Dependence

Organizations devote considerable effort to developing and implementing strategies to cope with environmental uncertainty and resource dependence. **Strategy** can be defined as the process by which top executives seek to cope with the constraints and opportunities posed by an organization's environment.

Strategy. The process by which top executives seek to cope with the constraints and opportunities that an organization's environment poses.

Exhibit 15.4 outlines the nature of the relationship between environment and strategy. At the top, the objective organizational environment is portrayed in terms of uncertainty and available resources, as we discussed above. However, much of the impact that the environment has on organizations is indirect rather than direct, filtered through the perceptual system of managers and other organizational members.[21] By means of the perceptual process we discussed in Chapter 3, personality characteristics and experience may colour managers' perceptions of the environment. For example, the environment might seem much more complex and unstable for a manager who is new to his job than for one who has years of experience. Similarly, the optimistic manager might perceive more resources than the pessimistic manager.[22] It is the perceived environment that comprises the basis for strategy formulation.

Strategy formulation itself involves determining the mission, goals, and objectives of the organization. At the most basic level, for a business firm, this would even involve consideration of just what business the organization should pursue. Then, the organization's orientation toward the perceived environment must be determined. This might range from being defensive and protective of current interests (such as holding market share) to prospecting vigorously for new interests to exploit (such as developing totally new products).[23] There is no single correct strategy along

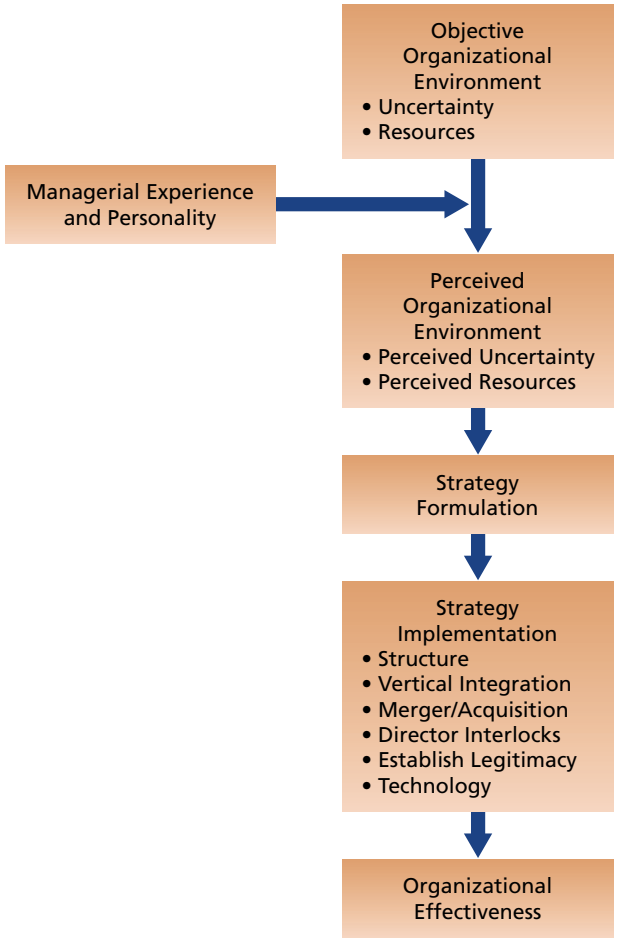


Exhibit 15.4
Environment, strategy, and organizational effectiveness.

this continuum. Rather, the chosen strategy must correspond to the constraints and opportunities of the environment. Finally, the strategy must be implemented by selecting appropriate managers for the task and employing appropriate techniques as shown in Exhibit 15.4.

Organizational Structure as a Strategic Response

How should organizations be structured to cope with environmental uncertainty? Paul Lawrence and Jay Lorsch of Harvard University have studied this problem.[24]

Lawrence and Lorsch chose for their research more and less successful organizations in three industries—plastics, packaged food products, and paper containers. These industries were chosen intentionally because it was assumed that they faced environments that differed in perceived uncertainty. This was subsequently confirmed by questionnaires and interviews. The environment of the plastics firms was perceived as very uncertain because of rapidly changing scientific knowledge, technology, and customer demands. Decisions had to be made even though feedback about their accuracy often involved considerable delay. At the opposite extreme, the container firms faced an environment that was perceived as much more certain. No major changes in technology had occurred in 20 years, and the name of the game was simply to produce high-quality standardized containers and get them to the customer quickly. The consequences of decisions could be learned in a short period of time. The perceived uncertainty faced by the producers of packaged foods fell between that experienced by the plastics producers and that faced by container firms.

Going a step further, Lawrence and Lorsch also examined the sectors of the environment that were faced by three departments in each company: sales (market envi-

ronment), production (technical environment), and research (scientific environment). Their findings are shown in Exhibit 15.5. The crucial factor here is the *range* of uncertainty across the subenvironments faced by the various departments. In the container companies, producing, selling, and research (mostly quality control) were all fairly certain activities. In contrast, the range of uncertainty encountered by the plastics firms was quite broad. Research worked in a scientific environment that was extremely uncertain. On the other hand, production faced a technical environment that was a good bit more routine.

When Lawrence and Lorsch examined the attitudes of organizational managers, the impact of perceived environmental uncertainty became apparent. First of all, because the departments of the plastics firms had to cope with sectors of the environment that differed in certainty, the plastics firms tended to be highly differentiated (Chapter 14). Thus, their managers tended to differ rather greatly in terms of goals, interpersonal relationships, and time spans. For example, production managers were interested in immediate, short-term problems, while managers in the research department were concerned with longer-range scientific development. Conversely, the container firms were not highly differentiated because the environmental sectors with which they dealt were more similar in perceived certainty. The food packaging firms were more differentiated than the container firms but less differentiated than the plastic companies.

Because they faced a relatively certain environment and since they were fairly undifferentiated, the container firms had adopted mechanistic structures. The most successful was organized along strict functional lines and was highly centralized. Coordination was achieved through direct supervision and formalized written schedules. All in all, this container firm conformed closely to the classical prescriptions for structure. At the other extreme, the most successful plastics companies had adopted organic structures. This was the most sensible way to deal with an uncertain environment and high differentiation. Decision-making power was decentralized to locate it where the appropriate knowledge existed. Coordination was achieved through informal mutual adjustment, ad hoc teams that cut across departments, and special integrators who coordinated between departments (Chapter 14). In addition, the departments themselves were structured somewhat differently, research being the most organic and production the least organic.

The Lawrence and Lorsch study is important because it demonstrates a close connection among environment, structure, and effectiveness. However, follow-up research has not been entirely supportive of their findings, and several contradictory studies exist.[25] Despite these spotty research findings, organizations very commonly tailor structure to strategy in coping with the environment.

For example, in order to make the company more flexible and entrepreneurial, McDonald's created a new decentralized regional structure in the United States consisting of regional divisions. Five new regional division heads have been appointed in order to create smaller companies within the larger McDonald's. The divisions

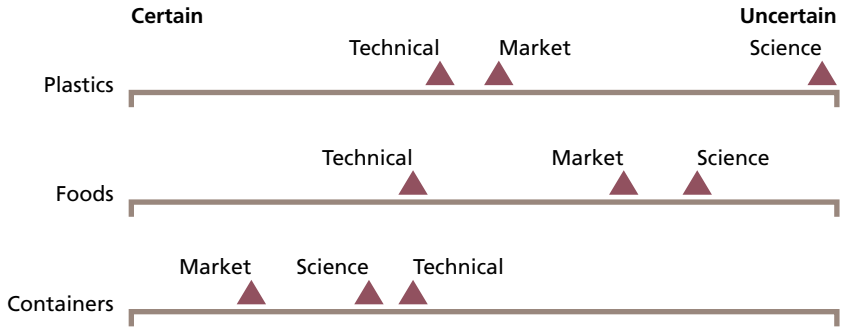


Exhibit 15.5
Relative perceived uncertainty of environmental sectors in the Lawrence and Lorsch study.

have their own staff functions, such as human resources, and a president who is responsible for results. As well, each division has autonomy over things like advertising, restaurant openings, and product development.[26]

Part of the GM Saturn organization's strategy is to reduce the development time for new models. This helps to counteract uncertainty in the marketplace. To implement the strategy, the company opted for a flatter, more organic, less bureaucratic structure for Saturn.

The argument presented so far suggests that strategy always determines structure, rather than the other way around. This is a reasonable conclusion when considering an organization undergoing great change or the formation of a new organization (such as Saturn). However, for ongoing organizations, structure sometimes dictates strategy formulation. For instance, highly complex decentralized structures might dictate strategies that are the product of political bargaining between functional units. More centralized simple structures might produce strategies that appear more rational and less political (although not necessarily superior in effectiveness).[27]

Other Forms of Strategic Response

Variations on organizational structure are not the only strategic response that organizations can make. Structural variations often accompany other responses that are oriented toward coping with environmental uncertainty or resource dependence. Some forms of strategy implementation appear extremely routine, yet they might have a strong effect on the performance of the organization. For example, economic forecasting might be used to predict the demand for goods and services. In turn, formal planning might be employed to synchronize the organization's actions with the forecasts. All this is done to reduce uncertainty and to predict trends in resource availability. Lobbying and public relations are also common strategic responses. Simple negotiating and contracting are other forms of implementing strategy. The innovative agreement between GM and the United Auto Workers regarding Saturn is one such example. General Motors' strategy involved guaranteeing itself a ready supply of flexible labour at somewhat less than the going wage rate at its other plants.

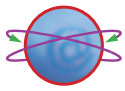
Some more elaborate forms of strategic response are worth a more detailed look. Notice how many of these concern relationships *between* organizations.

Vertical Integration. Many managers live in fear of disruption on the input or output end of their organizations. A lack of raw materials to process or a snag in marketing products or services can threaten the very existence of the organization. One basic way to buffer the organization against such uncertainty over resource control is to use an inventory policy of stockpiling both inputs and outputs. For example, an automaker might stockpile needed parts in advance of an anticipated strike at a supplier. At the same time, it might have 30 days' supply of new cars in its distribution system at all times. Both inventories serve as environmental "shock absorbers." A natural extension of this logic is **vertical integration**, the strategy of formally taking control of sources of supply and distribution.[28] Major oil companies, for instance, are highly vertically integrated, handling their own exploration, drilling, transport, refining, retail sales, and credit. Starbucks, the Seattle-based chain of espresso bars, imports, roasts, and packages its own coffee and refuses to franchise its bars in order to maintain high quality.

Vertical integration. The strategy of formally taking control of sources of organizational supply and distribution.

Vertical integration can reduce risk for an organization in many cases. However, when the environment becomes very turbulent, it can reduce flexibility and actually increase risk.[29] Managerial inefficiencies can also develop as a result of control and coordination difficulties, and various bureaucratic costs can also result. However, the results of a recent study indicates that the benefits of vertical integration outweigh the costs.[30]

Mergers and Acquisitions. In the last few years, there have been a number of very high profile mergers and acquisitions. Topping the list was the very bitter and highly contested merger between Hewlett-Packard Co. and Compaq Computer Corp. in which HP CEO Carly Fiorina had to contend with a shareholder revolt against her plan for the merger. Shareholders eventually approved the $19-billion merger, making it the largest technology merger ever. As well, a number of very big Canadian mergers and acquisitions made the headlines: Dupont Canada agreed to become a fully owned entity of U.S.-based E.I. du Pont de Nemours & Co. in a $1.4 billion buyout; Maple Leaf Foods Inc., Canada's largest meat processor, purchased Schneider Corp. in a deal said to be worth $515 million; Manulife Financial Corp. made an offer to purchase John Hancock Financial Services Inc. for $15 billion in a deal that would make it one of the biggest corporate takeovers in Canadian history and will make Manulife the second largest insurance company in North America and the fifth largest in the world; Alcan Inc. purchased rival Pechiney SA for an estimated $6.18 billion in what will make Alcan the biggest publicly-traded aluminum company in the world; and Alimentation Couche-Tard Inc., Canada's largest convenience store operator, purchased Circle K Corp. retail outlet and gas chain from Texas Oil giant ConocoPhillips Co. in a deal worth $1.1 billion.[31]

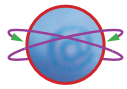


Maple Leaf Foods
www.mapleleaf.com

Manulife Financial Corp.
www.manulife.com

Such **mergers** or joining of two firms and the **acquisition** of one firm by another are increasingly common strategic responses. Some mergers and acquisitions are stimulated by simple economies of scale. For example, a motel chain with 100 motels might have the same advertising costs as one with 50 motels. Other mergers and acquisitions are pursued for purposes of vertical integration. For instance, a paper manufacturer might purchase a timber company. When mergers and acquisitions occur within the *same* industry, they are being effected partly to reduce the uncertainty prompted by competition. When they occur across *different* industries (a diversification strategy), the goal is often to reduce resource dependence on a particular segment of the environment. A portfolio is created so that if resources become threatened in one part of the environment, the organization can still prosper.[32] This was one motive for Philip Morris to take over food companies such as Kraft. Antismoking sentiments and legislation have provided much uncertainty for the firm's core cigarette business.

Mergers and acquisitions. The joining together of two organizations and the acquiring of one organization by another.



Philip Morris
www.philipmorris.com

Strategic Alliances. We have all heard about bad blood following a merger or acquisition, especially after a hostile takeover. This failure of cultures to integrate

Mergers of two firms or the acquisition of one firm by another such as Maple Leaf Foods' acquisition of Schneider Corp. have become increasingly common strategic responses in recent years.

smoothly (Chapter 8) is only one reason that mergers that look good from a financial point of view often end up as operational disasters. Is there any way to have the benefits of matrimony without the attendant risks? Increasingly, the answer seems to be **strategic alliances**—that is, actively cooperative relationships between legally separate organizations. The organizations in question retain their own cultures, but true cooperation replaces distrust, competition, or conflict for the project at hand. Properly designed, such alliances reduce risk and uncertainty for all parties, and resource *interdependence* is recognized. The network organization we discussed in the previous chapter is one form of strategic alliance.

Strategic alliances. Actively cooperative relationships between legally separate organizations.

Organizations can engage in strategic alliances with competitors, suppliers, customers, and unions.[33] Among competitors, one common alliance is a research and development consortium in which companies band together to support basic research that is relevant for their products. For example, several Canadian producers of audio speakers formed a consortium under the National Research Council to perfect the technology for "smart speakers" that adjust automatically to room configuration. Another common alliance between competitors is the joint venture, in which organizations combine complementary advantages for economic gain or new experience. The Toyota-General Motors joint venture in a California auto plant gave Toyota manufacturing access to the United States and gave GM experience with Japanese management techniques. This experience heavily influenced GM's subsequent decisions about how to structure and manage Saturn.

Strategic alliances with suppliers and customers have a similar theme of reducing friction and building trust and cooperation. At Union Pacific, for example, customers can place orders and track the progress of their own shipments by accessing UP's own mainframe. Finally, strategic alliances can occur between companies and unions. The innovative Saturn labour contract is just such an example.

Strategic alliances are most successful and stable when the senior managers of the firms meet frequently and when the firms behave "transparently" toward one another, exchanging information quickly and accurately. A prior history of cooperation and a feeling that the partner is not taking unfair advantage of the alliance are also important.[34]

Strategic alliances between global partners are increasingly common. Examples include the Ford-Mazda connection, the European Airbus consortium, and a Canon-Olivetti joint venture in copiers. These global alliances can be especially difficult to manage due to cross-cultural differences in expectations. For example, North Americans favour shorter time horizons and a rather direct approach to conflicts. East Asian cultures favour longer time horizons and "talking around" overt conflict.[35] (See "Global Focus: *Global Strategic Alliance to Develop New Computer Chip Leads to Cross-Cultural Confusion.*")

Interlocking Directorates. If we added up all the positions on boards of directors in the country and then added up all the people who serve as directors, the second number would be considerably smaller than the first. This is because of **interlocking directorates**, the condition that is said to exist when one person serves as a director on two or more boards. Such interlocking is legally prohibited when the firms are direct competitors; but as you can imagine, a fine line may exist as to the definition of a direct competitor. Many have recognized that interlocking directorates provide a subtle but effective means of coping with environmental uncertainty and resource dependence. The director's expertise and experience with one organization can provide valuable information for another. Sometimes the value of the interlock is more direct. This is especially true when it is a "vertical interlock" in which one firm provides inputs to or receives outputs from the other (for instance, a director might serve on the board of a steel company and that of an auto producer):

Interlocking directorates. A condition existing when one person serves on two or more boards of directors.

GLOBAL FOCUS

Global Strategic Alliance to Develop New Computer Chip Leads to Cross-Cultural Confusion

In addition to reducing uncertainty concerning inputs or outputs, a vertical interlock may also create a more efficient method of dealing with the environment. The outside director might be able not only to obtain the critical input but also to procure favourable treatment, such as a better price, better payment terms, or better delivery schedules. In addition, the search costs or the complexity involved in dealing with the environment may be reduced.[36]

Interlocks can also serve as a means of influencing public opinion about the wealth, status, or social conscience of a particular organization. Highly placed university officials, clergy, and union leaders are effectively board members in their own organizations, and they may be sought as board members by business firms to convey an impression of social responsibility to the wider public.[37] Resources are easier to obtain from a friendly environment than from a hostile environment!

Siemens AG
www.siemens.com

Toshiba
www.toshiba.com

Establishing Legitimacy. It is something of a paradox that environmental uncertainty seems to increase the need to make correct organizational responses but at the same time makes it harder to know which response is correct! One strategic response to this dilemma is to do things that make the organization appear *legitimate* to various constituents.[38] **Establishing legitimacy** involves taking actions that conform to prevailing norms and expectations. This will often be strategically correct, but equally important, it will have the *appearance* of being strategically correct. In turn, management will appear to be rational, and providers of resources will feel comfortable with the organization's actions.

Establishing legitimacy. Taking actions that conform to prevailing norms and expectations.

How can legitimacy be achieved? One way is by association with higher status individuals or organizations. For example, an organization without much established status might put a high-status outsider on its board or form a strategic alliance with a more prestigious partner. For example, consider how WestJet first established its legitimacy:

> In its formative year, the Calgary-based company had no direct experience in running an airline and it expected to be treated with skepticism by potential investors. To pre-empt this, it approached David Neeleman, former president of Morris Air, which had just been acquired by Dallas-based Southwest Airlines. Mr. Neeleman became one of WestJet's initial investors and jointed its board of directors. In this way, WestJet was able to demonstrate that it had not just a business plan that copied Southwest's successful style, but also an experienced entrepreneur on side, committed to the idea. WestJet took off. WestJet continues to pay attention to public legitimacy, or what its CEO, Clive Beddoe, describes as "winning the hearts and minds of customers and employees."[39]

Another way to achieve legitimacy is to be seen as doing good deeds in the community. Thus, many companies engage in corporate philanthropy and various charity activities. A third way is to make very visible responses to social trends and legal legislation. For example, many firms have appointed task forces and directors of workforce diversity or established official units to deal with employment equity guidelines. You might recall from Chapter 3 that the Bank of Montreal has an executive committee that overseas equity and diversity issues. Although such highly visible responses are not the only way to proceed with these matters, they do send obvious signals to external constituents that the organization is meeting social expectations. Probably the most common way of achieving legitimacy is to imitate management practices that other firms have institutionalized.

Attempts to achieve legitimacy can backfire. This is especially evident when management practices from other firms are copied without careful thought. Firms that "got on the bandwagon" of total quality management (a program aimed at improving the quality of an organization's goods and/or services, discussed in Chapter 16) or downsizing without clear rationale have often had unsuccessful experiences, despite the appearance of following recognized business trends.

The preceding are just a few examples of the kinds of strategic responses that organizations can implement to cope with the environment. Now, let us examine in greater detail another such response—technological choice.

The Technologies of Organizations

The term *technology* brings to mind physical devices, such as turret lathes, handsaws, computers, and electron microscopes. However, as we pointed out earlier, this is an overly narrow view of the concept. To broaden this view, we might define **technology** as the activities, equipment, and knowledge necessary to turn organizational inputs into desired outputs. In a hospital, relevant inputs might include sick patients and naive interns, while desired outputs include well people and experienced doctors. In a steel mill, crucial inputs include scrap metal and energy, while desired outputs consist of finished steel. What technologies should the hospital and the steel mill use to facilitate this transformation? More important for our purposes, do different technologies require different organizational structures to be effective?

Technology. The activities, equipment, and knowledge necessary to turn organizational inputs into desired outputs.

The concepts of *technology* and *environment* are closely related.[40] The inputs that are transformed by the technology come from various segments of the organization's environment. In turn, the outputs that the technology creates are returned to the environment. In addition, the activities, equipment, and knowledge that constitute the technology itself seldom spring to life within the organization. Rather,

they are imported from the technological segment of the environment to meet the organization's needs.

Organizations choose their technologies.[41] In general, this choice will be predicated on a desired strategy. For example, the directors of a university mental health centre might decide that they wish to deal only with students suffering from transitory anxiety or mild neuroses. Given these inputs, certain short-term psychotherapies would constitute a sensible technology. More disturbed students would be referred to clinics that have different strategies and different technologies.

Different parts of the organization rely on different technologies, just as they respond to different aspects of the environment as a whole. For example, the human resource department uses a different technology from the finance department. However, research has often skirted this problem, concentrating on the "core" technology used by the key operating function (e.g., the production department in manufacturing firms).

Basic Dimensions of Technology

Organizational technology has been defined, conceptualized, and measured in literally dozens of different ways.[42] Some analysts have concentrated on degree of automation; others have focused on the degree of discretion granted to workers. Here we will consider other classifications of technologies, specifically those of Charles Perrow and James D. Thompson. These classification schemes are advantageous because we can apply them both to manufacturing firms and to service organizations, such as banks and schools.

Perrow's Routineness. According to Perrow, the key factor that differentiates various technologies is the routineness of the transformation task that confronts the department or organization.[43] **Technological routineness** is a function of two factors:

Technological routineness. The extent to which exceptions and problems affect the task of converting inputs into outputs.

- *Exceptions*. Is the organization taking in standardized inputs and turning out standardized outputs (few exceptions)? Or is the organization encountering varied inputs or turning out varied outputs (many exceptions)? The technology becomes less routine as exceptions increase.
- *Problems*. When exceptions occur, are the problems easy to analyze or difficult to analyze? That is, can programmed decision making occur, or must workers resort to nonprogrammed decision making? The technology becomes less routine as problems become more difficult to analyze.

As Exhibit 15.6 demonstrates, the exceptions and problems dimensions can be arranged to produce a matrix of technologies. This matrix includes the following technologies:

- *Craft technologies* typically deal with fairly standard inputs and outputs. Cabinetmakers use wood to make cabinets, and public schools attempt to educate "typical" students. However, when exceptions are encountered (a special order or a slow learner), analysis of the correct action might be difficult.

Problems	Exceptions: Few	Exceptions: Many
Difficult Analysis	**Craft Technology** Cabinet Making Public School	**Nonroutine Technology** Research Unit Psychiatric Hospital
Easy Analysis	**Routine Technology** Assembly Line Vocational Training	**Engineering Technology** Heavy Machinery Construction Health Spa

Exhibit 15.6
Perrow's matrix of technologies.

Source: From Perrow, C. (1967, April). Framework for the comparative analysis of organizations, *ASR, 32*(2), Figures 1 and 2, pp. 196, 198. Copyright © 1967 by the American Sociological Association. Reprinted by permission.

- *Routine technologies,* such as assembly-line operations and technical schools, also deal with standardized inputs and outputs. However, when exceptions do occur (a new product line or a new subject to teach), the correct response is fairly obvious.
- *Nonroutine technologies* must deal frequently with exceptional inputs or outputs, and the analysis of these exceptions is often difficult. By definition, research units are set up to deal with difficult, exceptional problems. Similarly, psychiatric hospitals encounter patients with a wide variety of disturbances. Deciding on a proper course of therapy can be problematic.
- *Engineering technologies* encounter many exceptions of input or required output, but these exceptions can be dealt with by using standardized responses. For example, individuals with a wide variety of physical conditions visit health spas, and each has a particular goal (e.g., weight loss, muscle development). Despite this variety, the recommendation of a training regimen for each individual is a fairly easy decision.

From most routine to least routine, we can order Perrow's four technological classifications in the following manner: routine, engineering, craft, nonroutine. Shortly, we will consider which structures are appropriate for these technologies. First, let us examine Thompson's technological classification.

Thompson's Interdependence. In contrast to Perrow, James D. Thompson was interested in the way in which work activities are sequenced or "put together" during the transformation process.[44] A key factor here is **technological interdependence**, the extent to which organizational subunits depend on each other for resources, such as raw materials or information. In order of increasing interdependence, Thompson proposed three classifications of technology (Exhibit 15.7). These classifications are as follows:

Technological interdependence. The extent to which organizational subunits depend on each other for resources, raw materials or information.

Pooled interdependence. A condition in which organizational subunits are dependent on the pooled resources generated by other subunits but are otherwise fairly independent.

- *Mediating technologies* operate under **pooled interdependence**. This means that each unit is to some extent dependent on the pooled resources generated by the other units but is otherwise fairly independent of those units. Thompson gives rather abstract examples, such as banks, which mediate between depositors and borrowers, and post offices, which mediate between the senders and receivers of letters. However, the same argument can be applied more clearly to the branches of banks or post offices. The health of a bank as a whole might depend on the existence of several branches, but these branches operate almost independently of each other. Each has its own borrowers and depositors. Similarly, post office branches are dependent on other branches to forward and receive mail, but this is the limit of their required interaction. A taxi company is another good example of pooled interdependence.

Sequential interdependence. A condition in which organizational subunits are dependent on the resources generated by units that precede them in a sequence of work.

- *Long-linked technologies* operate under **sequential interdependence**. This means that each unit in the technology is dependent on the activity of the unit that preceded it in a sequence. The transformed product of each unit becomes a resource or raw material for the next unit. Mass production assembly lines are the classic example of long-linked technology. However, many "paper-processing" technologies, such as the claims department of an insurance company, are also sequentially interdependent (claims must be verified before they are adjusted and must be adjusted before they are settled).

Reciprocal interdependence. A condition in which organizational subunits must engage in considerable interplay and mutual feedback to accomplish a task.

- *Intensive technologies* operate under **reciprocal interdependence**. This means that considerable interplay and mutual feedback must occur between the units performing the task in order to accomplish it properly. This is necessary because each task is unique, and the intensive technology is thus a customized technology. One example might be the technology employed by a multidisciplinary research team. Thompson cites a general hospital as a prime example of intensive technology:

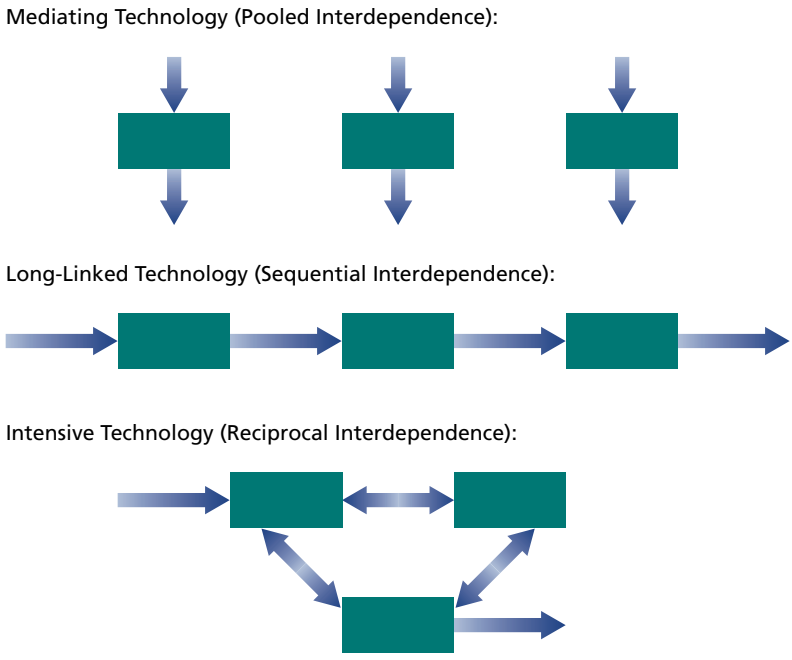


Exhibit 15.7
Thompson's technology classification.

> At any moment, an emergency admission may require some combination of dietary, x-ray, laboratory, and housekeeping or hotel services, together with the various medical specialities, pharmaceutical services, occupational therapies, social work services, and spiritual or religious services. Which of these is needed, and when, can be determined only from evidence about the state of the patient.[45]

As technologies become increasingly interdependent, problems of coordination, communication, and decision making increase. To perform effectively, each technology requires a tailored structure to facilitate these tasks.

Structuring to Cope with Technology

How does technology affect organizational structure?

Perrow. According to Perrow, routine technologies should function best under mechanistic structures, while nonroutine technologies call for more organic structures. In the former case, few exceptions to the normal course of events and easily analyzable problems suggest high formalization and centralization. In the latter case, many exceptions and difficult problems suggest that decision-making power should be located "where the action is." The craft and engineering technologies fall between these prescriptions. Research has generally supported his notion that more routine technologies adopt more mechanistic structures.[46]

Thompson. According to Thompson, increasing technological interdependence must be accompanied by increased coordination or integration mechanisms. There is research evidence to support this proposition.[47] Furthermore, the *methods* used to achieve coordination should be reflected in structural differences across the technologies. Mediating technologies, operating only under pooled interdependence, should be able to achieve coordination via standardization of rules, regulations, and procedures. This formalization is indicative of a mechanistic structure (consider banks and the post office). Long-linked technologies must also be structured mechanistically, but the increased demands for coordination prompted by sequential

interdependence must be met by planning, scheduling, and meetings. Finally, intensive technologies require intensive coordination, and this is best achieved by mutual adjustment and an organic structure that permits the free and ready flow of information among units.[48]

Woodward. The most famous study of the relationship between technology and structure is that of Joan Woodward. Woodward examined the technology, structure, and organizational effectiveness of 100 firms in South Essex, England.[49] This study is especially interesting because it began as an attempt to test the argument that mechanistic structures will prove most effective in all cases. In brief, this test failed—there was no simple, consistent relationship between organizational structure and effectiveness—and many of the successful firms exhibited organic structures. Woodward then analyzed and classified the technologies of the 80 firms in her sample that had clear-cut, stable production processes. She used the classifications unit, mass, and process production. Some examples of these classifications include the following:

- *Unit* (production of single units or small batches)
  Custom-tailored units
  Prototype production
  Fabrication of large equipment in stages (e.g., locomotives)
  Small batches to order
- *Mass* (production of large batches or mass production)
  Large batches on assembly lines
  Mass production (e.g., bakeries)
- *Process* (input transformed as an ongoing process)
  Chemicals processed in batches
  Continuous-flow production (e.g., gasoline, propane)

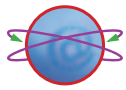
From top to bottom, this scale of technology reflects both increasing smoothness of production and increasing impersonalization of task requirements.[50] Less and less personal intervention is necessary as machines control more and more of the work. Woodward's mass technology incorporates aspects of Perrow's routine technology and Thompson's long-linked technology. Her unit technology seems to cover Perrow's craft and engineering technologies and some aspects of Thompson's intensive technology. It is difficult to isolate Woodward's process technology in the Perrow or Thompson classifications.

Now for the key questions. Did organizational structures tend to vary with technology? If so, was this variance related to organizational effectiveness? The answer in both cases is yes. Each of the three technologies tended to have distinctive structures, and the most successful firms had structures that closely approximated the average of their technological groups. For instance, Woodward found that as the production process became smoother, more continuous, and more impersonal, the management of the system took on increasing importance. That is, moving from unit to mass to process, there were more managers relative to workers, more hierarchical levels, and lower labour costs. This is not difficult to understand. Unit production involves custom-tailored craftswork in which the workers can essentially manage their own work activity. However, it is very labour intensive. On the other hand, sophisticated continuous-process systems (such as those used to refine gasoline) take a great amount of management skill and technical attention to start up. Once rolling, a handful of workers can monitor and maintain the system.

Successful firms with unit and process technologies relied on organic structures, while successful firms that engaged in mass production relied on mechanistic structures. For example, the latter firms had more specialization of labour, more controls, and greater formalization (a reliance on written rather than verbal communication). At first glance, it might strike you as unusual that the firms at the extremes of the

technology scale (unit and process) both tended to rely on organic structures. However, close consideration of the actual tasks performed under each technology resolves this apparent contradiction. Unit production generally involves custom-building complete units to customer specifications. As such, it relies on skilled labour, teamwork, and coordination by mutual adjustment and standardized skills. The work itself is not machine-paced and is far from mechanistic. At the other extreme, process production is almost totally automated. The workers are essentially skilled technicians who monitor and maintain the system, and they again tend to work in teams. While the machinery itself operates according to a rigid schedule, workers can monitor and maintain it at their own pace. Informal relationships with supervisors replace close control.

Woodward's research is a landmark in demonstrating the general proposition that structure must be tailored to the technology the organization adopts to achieve its strategic goals. Her findings have been replicated and extended by others.[51] However, there have been disconfirming studies, and a constant debate has gone on about the relative importance of organizational size versus technology in determining structure.[52] For an example of how technology can affect organizational structure, please consider the You Be the Manager feature, *Changing the Technology at Signicast Corp*.



Signicast Corp.
www. signicast.com

Saturn. The design of the Saturn organization shows evidence of an attempt to match structure to technology. In Woodward's terms, the core technology at Saturn is obviously mass production. However, some of its unique features, such as building automatic and manual transmissions on the same line to exactly match a car order, mean that the technology is somewhat less routine (in Perrow's terms) than the conventional monolithic assembly line. To take advantage of this, the shopfloor organization, with its work teams and reduced supervision, is more organic than is typical for the North American auto industry. This, then, is also reflected in the managerial and professional ranks, in which the technology for designing cars was modified. Instead of passing designs from department to department (Thompson's sequential interdependence), early involvement of all critical departments was obtained (Thompson's reciprocal interdependence). Again, this points to a more organic structure backed up by sophisticated electronic aids to facilitate coordination and communication. In fact, let us now turn our attention to advanced information technology.

Implications of Advanced Information Technology

In concluding the chapter, let us consider some of the implications that ongoing advances in information technology are having for organizational behaviour. Speaking broadly, **advanced information technology** refers to the generation, aggregation, storage, modification, and speedy transmission of information made possible by the advent of computers and related devices. Information technology is equally applicable in the factory or the office. In the factory, examples include robots, computer numerically controlled machine tools, and automated inventory management. In the office, it covers everything from word processing to e-mail to automated filing to expert systems. Between the office and the factory, it includes computer-aided design and engineering.

Advanced information technology. The generation, aggregation, storage, modification, and speedy transmission of information made possible by the advent of computers and related devices.

The Two Faces of Advanced Technology

It is important to recognize that there has been much inaccurate hoopla about advanced information technology. This began even before the first mainframe com-

You Be the Manager

Changing the Technology at Signicast Corp.

While the new automated continuous-flow processing technology would contribute to the objectives of speed, low cost, and flexibility, would other changes be necessary?

Signicast Corp., an investment castings manufacturer based in Milwaukee, had a major problem. In 1992, the company was landlocked in its Milwaukee facility. There was absolutely no more room for expansion. "If we wanted to continue to grow—and we very much wanted to—we'd have to buy some land and build," said Robert Schuemann, vice-president of sales and administration. "Why don't we build what we've always wanted? As long as we can start from a blank sheet of paper, we can design the best facility in the world."

So management decided to build a new $12 million automated plant. They began talking to customers to learn how Signicast could improve its investment-castings service, which makes precise metal parts direct to customers' blueprints, such as a kickstand for a Harley-Davidson motorcycle or a part for a John Deere tractor.

Customers' principal concerns were long lead times, unreliable delivery dates, and cost. Accordingly, the new plant would be designed to attack these concerns. The strategy for cutting lead time was to cut throughput-time (the time it takes to make a product from beginning to end). That, in turn, required converting production from batch processing (creating batches of product at intervals) to automated continuous-flow processing. "In a traditional shop, people spend most of their time trying to figure out what to do next," says Terry Lutz, Signicast's president. "With a control system and continuous-flow manufacturing, we're able to get the product to flow to the people. Everybody knows what to do, because that's what comes next." If an order starts on time, the process ensures it will ship on time, thus providing more reliable delivery dates.

A core group of five executives started planning the new facility to be built in Hartford, about 25 miles northwest of the existing Milwaukee facility. Every Signicast employee had an opportunity to contribute to the new facility. An early decision was made to build the new plant as a small module, designated Hartford 1, that would handle a closely related product mix for which Signicast would develop business. If successful, Signicast would then build a second facility, Hartford 2, and develop a product mix for that module. Each module would be a stand-alone operation.

While the new technology would contribute to the objectives of speed, low cost, and flexibility, would other changes be necessary? Manufacturing throughput-times were to be only three to five days versus approximately 25 days at Milwaukee. Signicast would achieve low costs only if production was right the first time, every time. Thus, the executive team resolved that no space would be allocated to rework. Signicast employees at Milwaukee, working within the batch-processing technology, perform only one highly specialized job consistent with a mechanistic organizational structure. However, management realized that Hartford personnel would have to do more and have more responsibility than their counterparts at Milwaukee.

What else would have to change as result of the new automated and continuous-flow technology and the objectives of low costs, speed, and flexibility? You be the manager.

Questions

1. How will the change in technology at Signicast affect organizational structure? Refer to Perrow, Thompson, and Woodward to answer this question.
2. What changes do you think Signicast made in order to tailor the organization's structure to the new technology?

To find out what Signicast did, consult The Manager's Notebook at the end of the chapter.

Source: Based on Nagler, B. (1998, January). Recasting employees into teams. *Workforce*, 77(1), 101–106.

puters were perfected, and it continues today. To exaggerate only slightly, doomsayers have painted a dark picture of job loss and de-skilling, with technology running wild and stifling the human spirit. Opponents of this view (often vendors of hardware and software) have painted a rosy picture of improved productivity, superior decision making, and upgraded, happy employees. It probably does not surprise you that research fails to support either of these extremes as a general state of affairs. In the early days of mainframe batch data processing, de-skilling, job pacing, and loss of routine clerical jobs did occur. However, as we shall see, the consequences of current advanced information technology are much less deterministic.

This discussion of extremes alerts us to a more realistic issue that we might call the "two faces" of technology.[53] This means that a given form of advanced information technology can have exactly *opposite* effects, depending on how it is employed. For example, the same system that is designed to monitor and control employees (say, by counting keystrokes) can also provide feedback and reduce supervision. Additionally, the same technology that can de-skill jobs can build skills *into* jobs. How can these opposite effects occur? They are possible because information technology is so *flexible*. In fact, we are discussing information technology separately from the core technologies discussed earlier because it is so flexible that it can be applied in conjunction with any of them.

The flexibility of information technology means that it is not deterministic of a particular organization structure, or job design. Rather, it gives organizations *choices* about how to organize work. The company that wishes to decentralize can use information technology to provide lower-level employees with data to make decisions. The company that wishes to centralize can use the other face of the same technology to gather information from below to retain control. Such choices are a function of organizational culture and management values rather than inherent in the hardware. They should match the strategy the organization is pursuing, as our discussion of advanced manufacturing will show.

For purposes of discussion, we will distinguish between advanced manufacturing technology and advanced office technology. However, as we shall see, this distinction is artificial, since advanced technology has the capability to link the office more closely to the factory or to clients, customers, and suppliers in the outside environment.

Advanced Manufacturing Technology

Three major trends underlie advanced manufacturing technology.[54] The first is an obvious capitalization on computer intelligence and memory. The second is flexibility, in that the technology can accomplish a changing variety of tasks. This is usually the product of an organizational strategy that favours adaptiveness, small batch production, and fast response. In turn, this strategy follows from attempting to find and exploit short-term "niches" in the marketplace rather than hoping to produce large volumes of the same product year after year. Consider this textile firm:

> Milliken has reduced its average production run from 20,000 to 4,000 yards and can dye lots as small as 1,000 yards. Apparel makers, textile and fibre firms, and retailers have recently joined to launch the so-called Quick Response program, designed to improve the flow of information among the various groups and speed order times. The program's goal is to cut the 66-week cycle from fibre to retail in the United States to 21 weeks.[55]

The same thing is happening in the auto industry, where there is a trend towards more efficient flexible manufacturing systems. With flexible manufacturing, a plant can manufacture a number of different vehicles in the same plant rather than just one vehicle, which used to be standard practice. A good example of this is Honda of Canada Manufacturing Inc. in Alliston, Ontario. The plant produces the Odyssey

minivan and the Pilot SUV for Honda and the MD-X for the automaker's luxury Acura line. On another assembly line, Civic sedans and Acura 1.7EL models are made. With flexible manufacturing, the plant can switch to another vehicle simply by reprogramming the robots in the body shop. Flexible manufacturing also makes it possible to serve smaller niches, something that would not be profitable in a traditional plant that is designed to manufacture large numbers of a single vehicle.[56]

As a third trend, advanced manufacturing technologies are increasingly being designed to be integrated with *other* advanced technologies that organizations use. For example, the computer-aided design system that is used to design and modify a product can also be used to design, operate, and modify its production process via computer-aided manufacturing programs (the result being a so-called CAD/CAM system). Ultimately, using most of the technologies mentioned here, computer-integrated manufacturing systems (CIM) that integrate and automate all aspects of design, manufacturing, assembly, and inspection can be put in place. In turn, computerized information systems can link these tasks to supply and sales networks. Exhibit 15.8 compares highly flexible manufacturing systems with traditional mass production.[57]

What are the general implications of advanced manufacturing technology for organizational behaviour? Such technology tends to automate the more routine information-processing and decision-making tasks. Depending on job design, what might remain for operators are the more complex, nonroutine tasks—those dealing with system problems and exceptions. In addition, task interdependence tends to increase under advanced technologies. For example, design, manufacturing, and marketing become more reciprocally than sequentially interdependent in a flexible manufacturing system. Finally, let us remember that such advanced technologies are adopted, in part, to cope with a less certain environment. Thus, many advanced technological systems result in nonroutine, highly interdependent tasks that are embedded in an uncertain environment.[58]

Organizational Structure. What are the implications of this shift in technology? As Exhibit 15.8 shows, one effect is a movement toward flatter, more organic structures to capitalize on the technology's flexibility.[59] This corresponds to Woodward's finding that unit technologies require more organic designs than mass technologies, and the adoption of more flexible, short-term production batches is an example of unit technology. The expectation of flatter structures stems from the fact that more highly automated systems will handle information processing and diagnoses that were formerly performed by middle managers. Implications of advanced technology for centralization are interesting. On the one hand, matters such as

Exhibit 15.8
Flexible manufacturing compared with traditional mass production.

Organizational Characteristic	Flexible Manufacturing	Mass Production
Strategy	• Adapt to environment • Produce small batches • Small inventory, fast turnover • Respond fast	• Buffer against environment • Produce large batches • Large inventory, slow turnover • Respond predictably
Product	• Many variations, variable life cycles	• Few variations, long life cycles
Marketing	• Exploit niche markets	• Cater to mass market
Structure	• Organic, integrated	• Mechanistic, differentiated
Suppliers	• Few, chosen for reliability and responsiveness	• Many, chosen on basis of cost
Jobs	• Flexible jobs; teamwork	• Rigid, specialized jobs; little teamwork

ordering raw materials and scheduling production should become more highly centralized. This is both required by the flexibility of the system and permitted by its enhanced information-processing capability. On the other hand, when problems or exceptions occur or when new designs are conceived, decentralization might be called for to locate decision making in the hands of lower-level specialists. However, the whole thrust of advanced technology dictates greater integration among specialities, such as design, engineering, production, and marketing. This might require a retreat from the rigid functional structures (Chapter 14) that are common in manufacturing firms. Minimally, it suggests the increased use of integrators, task forces, planning committees, and other mechanisms that stimulate coordination. One study of 185 firms that adopted advanced manufacturing technology found a general trend toward decentralization with more formalized rules and procedures to ensure coordination and effective exploitation of the technology.[60] However, another recent study on the effects of computer-based technology in manufacturing organizations found that it reduced the number of levels in the hierarchy and centralized operational authority and influence.[61]

Job Design. Advanced manufacturing technology can be expected to affect the design of jobs, and this is where the issue of choice we alluded to earlier clearly comes into play. There is evidence that such technology can reduce worker control over shopfloor jobs and water down existing skills.[62] An example is having skilled machinists operate lathes that have been programmed by a remote technician. However, other choices are possible, including teaching the machinists to program the lathe or at least to edit existing programs for local conditions. The latter approaches have been shown to gain cooperation and commitment to the new technology and to enhance performance.[63] Following this logic, since advanced technology tends to automate routine tasks, operative workers must usually acquire advanced skills (e.g., computer skills). Also, since advanced technology tends to be flexible as well as expensive to operate, workers themselves must be flexible and fast to respond to problems. Extreme division of labour can be counterproductive in advanced technology. For example, operators simply might not be able to wait for someone else to perform routine maintenance and thus might have to have the flexibility to do this themselves. Similarly, traditional distinctions between roles (electrical maintenance versus mechanical maintenance or drafting versus design) begin to blur when the needs for coordination that advanced technology imposes are recognized.

All this points to the design of jobs for advanced manufacturing technology according to the principles of job enrichment we discussed in Chapter 6. In turn, this suggests that proper training is critical and that pay levels should be revised to fit the additional skills and responsibilities prompted by the technology. Many observers have recommended that self-managed teams (Chapter 7) be made responsible for setting up, running, and maintaining the system.[64] In fact, GM has adopted this scheme for the Saturn plant. Such teams permit cross-transfer of skills and provide the cross-task integration that is necessary to keep things working smoothly. The team concept is also applicable to other forms of advanced technology. For example, one company organized its CAD/CAM users into teams composed of two designers, a draftsperson, and a toolmaker.[65]

Advanced Office Technology

As we noted above, the label *advanced office technology* can be applied sensibly to everything from word processing to exotic expert decision systems. Advanced office technology illustrates the coming together of some combination of three previously separate technologies—computers, office machines, and telecommunications (for example, a word processor combines a computer and a typewriter). The most common basic functions of the technology are the following:[66]

- Text processing
- Communication (e.g., e-mail, fax)
- Information storage and retrieval
- Analysis and manipulation of information
- Administrative support (e.g., electronic calendars)

As with advanced manufacturing technology, we can point to some environmental and strategic concerns that have stimulated the adoption of advanced office technology, although these concerns are more general. One is obviously the potential for *labour saving*. Consider, for example, word processing (revisions are easy), videoconferencing (a trip to the Coast is unnecessary), or spreadsheet analysis (many "What if?" scenarios can be probed by one manager). Another major concern stimulating the adoption of advanced technology is *responsiveness*, both within the organization and also to customers and suppliers. Speed and personalization of response are common goals. Finally, *improved decision making* is a goal of various decision support systems, expert systems, and the like.

The implications of advanced office technology are far reaching. What follows is an illustrative sample, again focusing on organizational structure and job design.

Organizational Structure. At least as it pertains to management jobs, the link between office technology and organizational structure has been dominated by two related issues—the impact of information technology on tallness/flatness and centralization. Regarding tallness and flatness, advanced technology has enabled a reduction in the number of supervisory and middle-management personnel.[67] Fewer supervisors are needed because electronic monitoring and feedback often replace routine supervision, and existing supervisors can handle larger spans of control. With fewer supervisors, fewer middle managers are required. Also, some advanced technology, such as decision support and expert systems, can make up for analyses performed by middle managers. For its size (over 200,000 employees), FedEx is a flat organization, having only five levels. This is due, in part, to advanced electronic communication systems.

Actual research evidence on all this is rather scanty and mainly targeted at the middle-management issue. Although there are reports of staff reductions, it is difficult to know how much of this is a direct result of office technology as opposed to the imposition of flatness to make organizations more responsive to the external environment. Some research points to increased demands on middle-management jobs as larger spans require them to be in charge of more diverse areas and as their performance is more monitorable by top management due to the technology.[68]

The impact of advanced office technology on centralization of decision making is variable, precisely as it should be.[69] Again, the key is the extreme flexibility of information technology. The same systems that allow senior managers to meddle in lower-level operations might enable junior staffers to assemble data and make decisions. Notice, though, that advanced technology does imply a freer, more democratic flow of information and general communication. This suggests that advanced technology enables a wider range of people at more levels to be involved in organizational decision making.[70] Exactly how this capacity gets played out in decision-making practice is most likely a function of strategy and prevailing culture.

Job Design. The impact of advanced office technology on job design and related quality of working life differs considerably with job status. Among clerical and secretarial employees, when jobs have not been lost altogether, there is the potential for de-skilling and reduced motivating potential.[71] A good case in point occurred in many organizations when word processing was introduced. Because the equipment was then expensive, secretarial support was often shifted into word processing pools to make efficient use of the hardware.[72] This frequently resulted in task specializa-

tion and a reduction in task identity. However, most observers agree that such technology can actually upgrade skills if it is used to optimal capacity and the work is not highly fragmented.[73] In fact, one study found that the extent to which computers have a positive or negative effect on job characteristics depends on several factors, such as the amount of time spent on computing and noncomputing components of a job, the nature of the work done on the computer, and the nature of the work that is done apart from the computer.[74]

Turning to quality of working life, word processing and related video display work have been known to provoke eyestrain, muscular strain, and stress symptoms. However, proper work station design and work pacing can help cope with these problems. Computer monitoring (such as counting keystrokes or timing the length of phone calls by service workers) has also been linked to stress reactions. However, there are studies that show that such monitoring may be viewed favourably by employees when it is used for job feedback rather than as a basis for punishment.[75] However, some forms of monitoring that are meant to improve communication between workers in different locations might have a number of negative consequences. To learn more, see "Research Focus: *The Psychological Effects of Awareness Monitoring Technology.*"

The Psychological Effects of Awareness Monitoring Technology

Imagine having a camera mounted on your computer monitor that captures your actions (and whatever you happen to be doing at the time) and transmits these images to your colleagues around the world. Sound far-fetched? Well, new technologies, called *awareness monitoring systems* or *benign surveillance systems* are being designed to enhance communication between geographically-distributed colleagues (e.g., teleworkers, multi-national team members). The idea behind awareness monitoring is that if I know where my colleague is, we can communicate more effectively. Awareness monitoring systems have been implemented in organizations such as Nynex and Xerox in the United States.

With over 78 percent of firms in the U.S. already engaging in some form of electronic monitoring, these new awareness technologies raise a number of important questions about employee surveillance. For example, do people really want to be monitored so closely at work? Will these new technologies really enhance communication and collaboration? To answer these questions, David Zweig and Jane Webster asked over 600 people to share their perceptions of awareness monitoring systems.

It was no surprise that, overall, people found these systems to be highly invasive and unfair. People questioned the usefulness of the technology and even suggested that they would not work for an organization that implements awareness monitoring technologies. However, even when safeguards were put in place to protect privacy and respect fairness, people responded negatively to awareness monitoring technologies. Specifically, offering people control over how their awareness information is shared, giving them knowledge of who is using the system to determine their availability, limiting the frequency of image capture, and blurring their image still resulted in negative attitudes and low levels of acceptance as compared to when these privacy and fairness enhancing modifications were not available.

In a follow-up study, a potential reason for these findings emerged. People felt that the awareness monitoring system violated their personal boundaries for how much information they were willing to share with their colleagues—regardless of the privacy and fairness safeguards in place. Furthermore, all of the participants were concerned about having their performance evaluated by presence. In other words, having presence monitored by a technology that captures and transmits a person's image at a workstation to others at any point in time during the workday could serve as an inaccurate measure of performance.

What's the bottom line? As technology advances, and organizations continue to disperse geographically, there is little doubt that efforts to design and implement monitoring technologies to enhance communication will continue. However, any new technology that violates employee expectations of privacy and fairness might have a significant impact on employee satisfaction, stress, retention, and performance.

Source: From Zweig, D. and Webster, J. (2002). Where is the line between benign and invasive? An examintion of psychological bariers to the acceptance of awareness monitoring systems. *Journal of Organizational Behavior, 23,* 605–633. © 2002 John Wiley & Sons Ltd. Reproduced with permission..

the manager's Notebook

Changing the Technology at Signicast Corp.

1. Signicast Corp.'s shift to an automated continuous-flow processing technology is a good example of how a shift in technology can affect organizational structure. According to Perrow, routine technologies should function best under mechanistic structures while nonroutine technologies call for more organic structures. With the new continuous-flow technology, there is likely to be more exceptions and difficult problems compared with the batch-processing technology. Thus, decision-making power should be located "where the action is," and this is most likely to occur in an organic structure. According to Thompson, the continuous-flow technology would result in greater technological interdependence and would require intensive coordination. This would call for greater mutual adjustment and an organic structure for the free and ready flow of information among units. According to Woodward, we would once again expect a more organic structure. Woodward's research showed that successful firms with unit and process technologies relied on organic structures, while successful firms that engaged in mass production relied on mechanistic structures. Because process production is almost totally automated, the workers are usually skilled technicians who monitor and maintain the system, and they tend to also work in teams. As well, informal relationships with supervisors replace close control. Thus, all three theories predict an organic structure in which workers make decisions, coordinate their efforts, and work in teams. Now let us take a look at how the new technology actually changed the structure at Signicast.
2. The basic requirements for new hires at Milwaukee are a high school diploma and a good work ethic. No specific experience is sought because Signicast provides all necessary training. For the 135 new employees at Hartford, however, the same basic requirements were sought plus a team orientation, good trainability, good communication skills, and a willingness to do varied jobs over a 12-hour shift. These skills were now required because of changes in job design and working arrangements. For example, it was decided that employees at Hartford would not operate the same job for more than four to six hours as was the case at Milwaukee. Instead, employees would be cross-trained to do a variety of jobs, thus enabling them to move elsewhere in the plant to work and perform two or more jobs on a shift. This would make jobs more interesting, teach employees new skills, and reduce injuries. Thus, Hartford was structured so that people would move to the work rather than having the work moved to the people. Employees have the title of *technician* and operate equipment, inspection devices, and other aspects of the plant, while machines do the heavy grunt work. Signicast also created teams for the Hartford plant. Instructors from a local technical college were brought in to give 10-week team-building courses for two hours a week. The course covered habits, problem solving, team building, diversity, and other issues affecting how workers relate to their co-workers and work, and how they can solve problems as a team. A team consists of everyone on a given 12-hour shift. There are two day-teams (6 a.m. to 6 p.m.) and two night-teams (6 p.m. to 6 a.m.), and each team has its own supervisor. These teams have a large degree of input and impact. Many policies and procedures are put to a vote as to what team members want. Because the supervisor runs the entire plant, he or she has neither the time nor the inclination to do any straw boss-type supervision. Accordingly, empowered workers have to be both motivated and trained to do their jobs not only well but independently. In the end, Signicast was able to build a new kind of workforce along with a new kind of facility because management realized that in addition to technology, changes also had to be made in work arrangements, structure, and job design. The reduced supervision combined with the use of empowered work teams and cross-trained multiskilled employees created a more organic structure that was more suitable to the new automated technology.

On the whole, professionals and managers seem to have taken to advanced office technology remarkably well. Routine aspects of such jobs (such as doing tedious calculations) have often been replaced by more cerebral pursuits. One exception may be some semiprofessional jobs, such as drafting, in which de-skilling can occur without thoughtful job redesign.

There are many examples of organizations that have had poor success in introducing advanced technology because they ignored the human dimension. This raises the issue of implementing change in organizations, a concern of the next chapter.

Learning Objectives Checklist

1. *Organizations* are open systems that take inputs from the external environment, transform some of these inputs, and send them back into the environment as outputs. The *external environment* includes all the events and conditions surrounding the organization that influence this process. Major components of the environment include the economy, customers, suppliers, competitors, social/political factors, and existing technologies.

2. One key aspect of the external environment is its uncertainty. More uncertain environments are vague, difficult to diagnose, and unpredictable. Uncertainty is a function of complexity and rate of change. The most uncertain environments are complex and dynamic—they involve a large number of dissimilar components that are changing unpredictably. More certain environments are simple and stable—they involve a few similar components that exhibit little change. As environmental uncertainty increases, cause–effect relationships get harder to diagnose, and agreeing on priorities becomes more difficult because more information must be processed. Another key aspect of the external environment is the amount of resources it contains. Some environments are richer or more munificent than others, and all organizations are dependent on their environments for resources. Organizations must develop strategies for managing environmental uncertainty and resource dependence for their survival and success.

3. *Strategy* is the process that executives use to cope with the constraints and opportunities posed by the organization's environment, including uncertainty and scarce resources. One critical strategic response involves tailoring the organization's structure to suit the environment. In general, as the Lawrence and Lorsch study demonstrates, mechanistic structures are most suitable for more certain environments, and organic structures are better suited to uncertain environments.

4. Some of the more elaborate strategic responses include vertical integration, mergers and acquisitions, strategic alliances, interlocking directorates, and establishing legitimacy. Many of these involve relationships between organizations. Vertical integration involves taking control of sources of organizational supply and distribution; mergers and acquisitions involve two firms joining together or one taking over another; strategic alliances involve cooperative relationships between legally separate organizations; interlocking directorates exist when one person serves on two or more boards of directors; and establishing legitimacy involves taking actions that conform to prevailing norms and expectations.

5. *Technology* includes the activities, equipment, and knowledge necessary to turn organizational inputs into desired outputs. One key aspect of technology is the extent of its routineness. A routine technology involves few exceptions to usual inputs or outputs and readily analyzable problems. A nonroutine technology involves many exceptions that are difficult to analyze. Another key aspect of technology is the degree of interdependence that exists between organizational units. This may range from simple pooling of resources, to sequential activities, to complex reciprocal interdependence.

6. According to Perrow, routine technologies should function best under mechanistic structures, while nonroutine technologies call for more organic structures. According to Thompson, mediating technologies require formalization that calls for a mechanistic structure; long-linked technologies must also be structured mechanistically; and intensive technologies require intensive coordination which is best achieved with an organic structure. The most famous study of the relationship between technology and structure was Joan Woodward's. She determined that unit and process technologies performed best under organic structures, while mass production functioned best under a mechanistic structure. In general, less routine technologies and more interdependent technologies call for more organic structures.

7. Advanced information technology generates, aggregates, stores, modifies, and speedily transmits information. In the factory, it permits flexible manufacturing that calls for organic structures, enriched jobs, and increased teamwork. In the office and the organization as a whole, the flexibility of advanced information technology means that its effects are highly dependent on management values and culture.

OB FLASHBACK

New Production Processes Require Job Enrichment

During the last decade, there have been major changes taking place in manufacturing. The traditional practices epitomized by mass production are giving way to a new paradigm. Practices such as "lean production," "world class manufacturing," "integrated manufacturing," "time-based flexible manufacturing," and "new wave manufacturing" represent new manufacturing approaches that are aimed at making organizations more efficient and competitive.

These new approaches are designed to provide increased responsiveness to customer demands, by controlling costs and simultaneously improving quality and tailoring output more specifically to customer requirements. To accomplish this, they rely heavily on enabling technologies and techniques such as just-in-time (JIT) and total quality management (TQM). Total quality management is a systematic attempt to achieve continuous improvement in the quality of an organization's products and/or services.

A key question raised in the implementation of these approaches is whether they are sufficient in themselves to realize new competitive goals or whether wider individual and organizational change is also necessary. In particular, what is the role of employees and should their work be enriched, as discussed in Chapter 6?

In order to answer this question, Sharon Parker, Toby Wall, and Paul Jackson conducted two studies to examine the implementation of new production practices. They argued that the successful implementation of new manufacturing practices requires that production employees develop a broader role orientation that involves a concern for high product quality, customer satisfaction, working as part of a team, and understanding the importance of gaining and using a wide range of skills and knowledge required to perform effectively. Furthermore, the development of such a broader role orientation requires an increase in job autonomy.

The first study involved the implementation of a JIT-TQM initiative that did not involve any change in employees' autonomy in the assembly section of a company that designs and manufactures vehicle seats and seat mechanisms for car manufacturers in the United Kingdom and Europe. The second study involved the introduction of a JIT-TQM initiative that was accompanied by enhanced autonomy in the production department of an American-owned electronics company in the United Kingdom that designed and produced control equipment for use in process industries. Autonomous work teams (Chapter 7) were formed and multi-skilled employees were given the authority to manage day-to-day activities involved in meeting production targets and the responsibility for testing and quality inspection.

The results indicated that employees in the first study who did not experience a change in autonomy did not develop a broader and more proactive role orientation. In fact, they attached less importance to various skills and types of knowledge that would enable high performance. Employees in the second study whose job autonomy was enhanced developed a broader and more flexible role orientation. Overall, the adoption of the JIT-TQM initiative in this company was very successful. Lead times were reduced from 14 weeks to two days; inventory costs were reduced to 20 percent of the initial costs; delivery integrity (meeting customer delivery dates) was improved from 50 percent to 97 percent; and quality (monitored in terms of zero-defect boards and quality yield) was substantially improved.

The results of this research demonstrate that employees' jobs must be enriched so that they develop a broader and more flexible role orientation which is required for the successful implementation of new manufacturing practices.

Source: Parker, S. K., Wall, T. D., & Jackson, P. R. (1997). "That's not my job": Developing flexible employee work orientations. *Academy of Management Journal, 40*, 899–929. Reprinted with permission.

Discussion Questions

1. Construct a diagram of the various interest groups in the external environment of CBC Television. Discuss how some of these interest groups may make competing or contradictory demands on the CBC.
2. Give an example of vertical integration. Use the concept of resource dependence to explain why an organization might choose a strategic response of vertical integration.
3. Discuss how interlocking directorates might reduce environmental uncertainty and help manage resource dependence.
4. Explain why organizations operating in more uncertain environments require more organic structures.
5. Distinguish among pooled interdependence, sequential interdependence, and reciprocal interdependence in terms of the key problem each poses for organizational effectiveness.
6. Give an example of unit technology, mass technology, and process technology. For which type of technology are the prescriptions of the classical organizational theorists best suited?
7. Imagine that a company is converting from conventional mass technology to a highly flexible, computerized, integrated production system. List structural and behavioural problems that the company might have to anticipate in making this conversion.
8. Discuss this statement: The effects of advanced information technology on job design and organizational structure are highly predictable.

Integrative Discussion Questions

1. Consider the effect of environmental uncertainty and resource dependence on power and politics in organizations. To what extent is subunit power and organizational politics a function of environmental uncertainty and resource dependence? Does environmental uncertainty and resource dependence predict and explain the distribution and use of power and politics in organizations?
2. How does technology influence job design? Discuss the effect of technology according to Perrow, Thompson, and Woodward on the following approaches to job design described in Chapter 6: traditional views of job design, the Job Characteristics Model, and job enrichment.
3. Discuss the implications of mergers and acquisitions for organizational culture. In particular, consider mergers and acquisitions in light of the assets and liabilities of strong cultures. How will culture influence the success or failure of mergers and acquisitions, and what can organizations do to increase the chances of success?

Experiential Exercise

Diagnosing an Organization

The purpose of this exercise is to choose an organization and to diagnose it in terms of the concepts we covered in the chapter. Doing such a diagnosis should enable you to see better how the degree of "fit" among organizational structure, environment, strategy, and technology influences the effectiveness of the organization. The discussion throughout the chapter of the General Motors' Saturn organization provides a general model for the nature of the exercise.

This exercise is suitable for an individual or group project completed outside the class or a class discussion guided by the instructor. In the case of the group project completed outside the class, each group might choose and contact a local organization for information. Alternatively, library resources might be consulted to diagnose a prominent national or international organization. Your instructor might suggest one or more organizations for diagnosis.

1. Discuss in detail the external environment of the chosen organization.
   a) How has the general economy affected this organization recently? Is the organization especially sensitive to swings in the economy?
   b) Who are the organization's key customers? What demands do they make on the organization?
   c) Who are the organization's key suppliers? What impact do they have on the organization?
   d) Who are the organization's important competitors? What threats or opportunities do they pose for the organization?
   e) What general social and political factors (e.g., the law, social trends, environmental concerns) affect the organization in critical ways?
2. Drawing on your answers to question 1, discuss both the degree of environmental uncertainty and the nature of resource dependence the organization faces. Be sure to locate the firm or institution in the appropriate cell of Exhibit 15.3, and defend your answer.
3. What broad strategies (excluding structure) has the organization chosen to cope with its environment?
4. Describe in as much detail as possible the structure of the organization, and explain how this structure represents a strategic response to the demands of the environment. Is this the proper structure for the environment and broad

strategies that you described in response to the earlier questions?
a) How big is the organization?
b) What form of departmentation is used?
c) How big are the spans of control?
d) How tall is the organization?
e) How much formalization is apparent?
f) To what extent is the organization centralized?
g) How complex is the organization?
h) Where does the organization fall on a continuum from mechanistic to organic?

5. Describe the organization's core technology in terms of routineness (Exhibit 15.6) and interdependence (Exhibit 15.7). Is its structure appropriate for its technology?

6. What impact has advanced information technology had on the organization?

Case Incident

GTE

Telephone operations account for four-fifths of GTE's $20 billion in annual revenues. With deregulation, the telephone business has become intensely competitive, and GTE was looking for ways to both cut costs and improve customer service. Improved service can reduce service costs in the field, improve existing customers' relationships, and attract new customers. The traditional approach to such improvements has been to try to "fine tune" existing procedures in the repair, billing, and marketing departments. However, GTE saw merit in trying to totally reengineer the way customers interacted with the company to make the process more efficient and satisfying, perhaps using some of its own technology.

GTE was using a traditional system in which a customer needing repair service called an operator who took down basic information and then bounced the customer around various departments until someone could solve his or her problem. This system of passing on customers was both expensive and inefficient. What if a single customer wanted to question a bill, obtain a calling card, and report a dial tone problem?

1. Describe the external environment of GTE and the relevant components of it. What influence does the external environment have on GTE?

2. What would you do to improve customer service at GTE and how does advanced information technology provide opportunities for improved customer service?

Sources: Greengard, S. (1993, December). Reengineering: Out of the rubble. *Personnel Journal*, 48A–48O; Brain Blevins, GTE; Sager, I. (1994). The great equalizer. *Business Week* (Special issue: The Information Revolution). 100–107; Stewart, T. A. (1993, August 23). Reengineering: The hot new management tool. *Fortune*, 41–48.

Case Study

Philips NV

Introduction

Established in 1891, the Dutch company Philips NV is one of the world's largest electronics enterprises. Its businesses are grouped into four main divisions: lighting, consumer electronics, professional products, (computers, telecommunications, and medical equipment), and components (including chips). In each of these areas, it ranks alongside the likes of Matsushita, General Electric, Sony, and Siemans as a global competitor. In the late 1980s, the company had several hundred subsidiaries in 60 countries, it operated manufacturing plants in more than 40 countries, it employed approximately 300,000 people, and it manufactured thousands of different products. However, despite its global reach by 1990, Philips was a company in deep trouble. After a decade of deteriorating performance, in 1990 Philips lost $2.2 billion on revenues of $28 billion. A major reason seems to have been the inability of Philips to adapt to the changing competitive conditions in the global electronics industry during the 1970s and 1980s.

Philips' Traditional Organization

To trace the roots of Philips' current troubles, one has to go back to World War II. Until then, the foreign activities of Philips had been run from its head office in Eindhoven. However, during World War II, the Netherlands was occupied by Germany. Cut off from their home base, Philips' various national organizations began to operate independently. In essence, each major national organization developed into a self-contained company with its own manufacturing, marketing, and R&D functions.

Following the war, top management felt that the company could be most successfully rebuilt through its national organizations. There were several reasons for this belief. First, high trade barriers made it logical that self-contained national organizations be established in each major national market. Second, it was felt that strong national organizations would allow Philips to be responsive to local demands in each country in which it competed. And third, given the substantial autonomy that the various national organizations had gained during the war, top management felt that reestablishing centralized control might prove difficult and yield few benefits.

At the same time, top management felt the need for some centralized control over product policy and R&D in order to achieve some coordination between national organizations. Its response was to create a number of worldwide product divisions (of which there were 14 by the mid-1980s). In theory, basic R&D and product development policy were the responsibilities of the product divisions, whereas the national organizations were responsible for day-to-day operations in a particular country. Product strategy in a given country was meant to be determined jointly by consultation between the responsible national organization and the product divisions. It was the national organizations that implemented strategy.

Another major feature of Philips' organization was the dummvirate form of management. In most national organizations, top-management responsibilities and authority were shared by two managers—one responsible for "commercial affairs" and another responsible for "technical activities." This form of management had its origins in the company's founders—Anton and Gerard Philips. Anton was a salesman and Gerard an engineer. Throughout the company, there seemed to be a vigorous, informal competition between technical and sales managers, with each attempting to outperform the other. Anton once noted:

> The technical management and the sales management competed to outperform each other. Production tried to produce so much that sales would not be able to get rid of it; sales tried to sell so much that the factory would not be able to keep up [Aguilar and Yoshino, 1987].

The top decision-making and policy-making body in the company was a 10-person board of management. While board members all shared general management responsibility, they typically maintained a special interest in one of the functional areas of the company (for example, R&D, manufacturing, marketing). Traditionally, most of the members of the management board were Dutch and had come up through the Eindhoven bureaucracy, although most had extensive foreign postings, often as a top manager in one of the company's national organizations.

Environmental Change

From the 1960s onward, a number of significant changes took place in Philips' competitive environment that were to profoundly affect the company. First, due to the efforts of the General Agreement on Tariffs and Trade (GATT), trade barriers fell worldwide. In addition, in Philips' home base, Europe, the emergence of the European Economic Community, of which the Netherlands was an early member, led to a further reduction in trade barriers between the countries of Western Europe.

Second, during the 1960s and 1970s a number of new competitors emerged in Japan. Taking advantage of the success of GATT in lowering trade barriers, the Japanese companies produced most of their output at home and then exported to the rest of the world. The resulting economies of scale allowed them to drive down unit costs below those achieved by Western competitors, such as Philips, that manufactured in multiple locations. This significantly increased competitive pressures in most of the business areas where Philips competed.

Third, due to technological changes, the cost of R&D and manufacturing increased rapidly. The introduction of transistors and then integrated circuits called for significant capital expenditures in production facilities—often running into hundreds of millions of dollars. To realize scale economies, substantial levels of output had to be achieved. Moreover, the pace of technological change was declining and product life cycles were shortening. This gave companies in the electronics industry less time to recoup their capital investments before new-generation products came along.

Finally, as the world moved from a series of fragmented national markets toward a single global market, uniform global standards for electronic equipment were beginning to emerge. This standardization showed itself most clearly in the videocassette recorder business, where three standards initially battled for dominance—the Betamax standard produced by Sony, the VHS standard produced by Matsushita, and the V2000 standard produced by Philips. The VHS standard was the one most widely accepted by consumers, and the others were eventually abandoned. For Philips and Sony, both of which had invested substantially in their own standard, this was a significant defeat. Philips' attempt to establish its V2000 format as an industry standard was effectively killed off by the decision of its own North American national organization, over the objections of Eindhoven, to manufacture according to the VHS standard.

Organizational and Strategic Change

By the early 1980s, Philips realized that if it was to survive, it would have to restructure its business radically. Its cost structure was high due to the amount of duplication across national organizations, particularly in the area of manufacturing. Moreover, as the V2000 incident demonstrated, the company's attempts to compete effectively were being hindered by the strength and autonomy of its national organizations.

The first attempt at change came in 1982 when Wisse Dekker was appointed CEO. Dekker quickly pushed for manufacturing rationalization, creating international production centres that served a number of national organizations and closing many small inefficient plants. He also pushed Philips to enter into more collaborative arrangements with other electronics firms in order to share the costs and risks of developing new products. In addition, Dekker accelerated a trend that had already begun within the company to move away from the dual leadership arrangement within national organizations (commercial and technical), replacing this arrangement with a single general manager. Furthermore, Dekker tried to "tilt" Philips' matrix away from national organizations by creating a corporate council where the heads of product divisions would join the heads of the national organizations to discuss issues of importance to both. At the same time, he gave the product divisions more responsibility to determine companywide research and manufacturing activities.

In 1986, Dekker was succeeded by Cor van de Klugt. One of van de Klugt's first actions was to specify that profitability was to be the central criterion for evaluating performance within Philips. The product divisions were given primary responsibility for achieving profits. This was followed in late 1986 by his termination of the U.S. Philips trust, which had been given control of Philips' North American operations during World War II and which still maintained control as of 1986. By terminating the trust, van de Klugt, in theory, reestablished Eindhoven's control over the North American subsidiary. Then, in May 1987, van de Klugt announced a major restructuring of Philips. He designated four product divisions—lighting, consumer electronics, components, and telecommunications and data systems—as "core divisions," the implication being that other activities would be sold off. At the same time he reduced the size of the management board. Its policy-making responsibility was devolved to a new group management committee, comprising the remaining board members plus the heads of the core product divisions. No heads of national organizations were appointed to this

body, thereby further tilting power within Philips away from the national organizations toward the product divisions.

Despite these changes, Philips' competitive position continued to deteriorate. Many outside observers attributed this slide to the dead hand of the huge head office bureaucracy at Eindhoven (which comprised more than 3,000 people in 1989). They argued that while van de Klugt had changed the organizational chart, much of this change was superficial. Real power, they argued, still lay with the Eindhoven bureaucracy and their allies in the national organizations. In support of this view, they pointed out that since 1986 Philips' workforce had declined by less than 10 percent, instead of the 30 percent reduction that many analysts were calling for.

Alarmed by a 1989 loss of $1.06 billion, the board forced van de Klugt to resign in May 1990. He was replaced by Jan Timmer. Timmer quickly announced that he would cut Philips's worldwide workforce by 10,000 to 283,000, and launch a $1.4 billion restructuring. Investors were unimpressed—most of them thought that the company needed to lose 40,000 to 50,000 jobs—and reacted by knocking the share price down by 7 percent. Since then, however, Timmer had made some progress. In mid-1991, he sold off Philips's minicomputer division—which at the time was losing $1 million per day—to Digital Equipment. He also announced plans to reduce costs by $1.2 billion by cutting the workforce by 55,000. In addition, he entered into a strategic alliance with Matsushita, the Japanese electronic giant, to manufacture and market the Digital Compact Cassette (DCC).

Source: Hill, C. W. L., University of Washington. From Jones, G. (1993). *Organizational theory: Text and cases*, 2nd ed. Addison Wesley (Reading). Reprinted with permission.

1. Discuss the role the environment played in terms of the strategy and structure of Philips prior to the 1960s.
2. Discuss the environmental components of Philips that have been exerting influence since the 1960s.
3. Apply the concepts of environmental uncertainty, resource dependence, and strategy to the Philips case.
4. Discuss Philips's first attempt to cope and change with Wisse Dekker as CEO considering the interplay among strategy, structure, and technology. Why was this program not more successful?
5. Discuss Philips's second attempt to cope and change with Cor van de Klugt as CEO again considering the interplay among strategy, structure, and technology. Why was this program not more successful?
6. Discuss Philips's third attempt to cope and change with Jan Timmer as CEO again considering the interplay among strategy, structure, and technology. Will this program be more successful than the previous two?
7. Not all efforts at organizational change turn out successfully. What strategic responses were used by Philips to try to cope with environmental uncertainty, and how successful were they? Would other strategic responses have been more successful?
8. Describe the technology of Philips. What role did technology play in the problems experienced by Philips, and how might changes in technology lead to improvements?